IN THE CLAIMS

This listing of the claims will replace all prior versions, and listing, of claims in the application or previous response to office action:

1. (Currently Amended) A method for pseudo-physically modeling the erosion ~~rate~~ of the surface of a workpiece being polished by a stack of polishing pads including a base pad and a top pad, said method comprising the steps of:

a) determining the contact force between the surface of the workpiece being polished and the stack of polishing pads by:

1) equating the base pad to a first abstract mathematical spring having compressibility factor k1;

2) equating the top pad to a second abstract mathematical spring having compressibility factor k_2;

3) said first and second abstract mathematical springs being connected together in series;

4) determining the force on the stack of polishing pads by determining the combined deflection of the base pad and the top pad;

b) equating the force on the stack of polishing pads to the force on the surface of the workpiece being polished;

c) determining the erosion rate of the surface of the workpiece being polished by multiplying the force on the surface of the workpiece being polished by a predetermined constant.

2. (Original) The method for pseudo-physically modeling as defined in Claim 1 wherein a compressibility factor k_1 is selected for a predetermined erosion rate of the surface of the workpiece.

3. (Original) The method for pseudo-physically modeling as defined in Claim 1 wherein a compressibility factor k_2 is selected for a predetermined erosion rate of the surface of the workpiece.

4. (Original) The method for pseudo-physically modeling as defined in Claim 1 wherein said force on the surface of the workpiece being polished is selected for a predetermined erosion rate of the surface of the workpiece.

5. (Original) The method for pseudo-physically modeling as defined in Claim 1 wherein the force on the stack of polishing pads is obtained by dividing the stack of polishing pads and the surface of the workpiece being polished into a plurality of individual nodes *i*.

6. (Original) The method for pseudo-physically modeling as defined in Claim 5 wherein each node *i* of the stack of polishing pads has an adjacent node *j*.

7. (Original) The method for pseudo-physically modeling as defined in Claim 6 wherein:

the spring force on a node *i* in the base pad is the product of said compressibility factor k_1, the deflection of the base pad, and the area of said node *i*, and

wherein the spring force on a node *i* in the top pad is the product of said compressibility factor k_2, the deflection of the top pad, the length of contact between node *i* and an adjacent node *j* and the thickness of the top pad.

8. (Original) The method for pseudo-physically modeling as defined in Claim 6 wherein:

the force F_{1i} from a base pad node is computed using the formula:

$$F_{Ii} = -rk_I (p_o - z_{pi}) dx_i dy_i$$

where $-rk_I$ is a Hookean spring constant

p_o-z_{pi} is the amount of deflection of the base pad

$dx_I\ dy_I$ is the size of the node.

9. (Original) The method for pseudo-physically modeling as defined in Claim 8 wherein:

the force F_{2ij} from a top pad node is computed using the formula:

$$F_{2ij} = rk_2 (z_{pj} - z_{pi}) l_{ij} h$$

where rk_2 is a Hookean spring constant

$(z_{pj} - z_{pi})$ is the amount of deflection of the top pad

$l_{ti} h$ is the size of the node.

10. (Original) The method for pseudo-physically modeling as defined in Claim 9 wherein:

the nodal contact force is computed using the formula:

$$f_i = F_{Ii} + \sum_{j=I}^{m_i} F_{2[i][mi(j)]}$$

11. (Original) A method for simulating the performance of a system for chemical mechanical polishing of the surface of a workpiece by a moving pad, said method comprising the steps of:

a) modeling the surface of the workpiece by a collection of nodes located in a plane *w*, each of said wafer nodes having a location defined by the Cartesian coordinates x_{wi}, y_{wi}, z_{wi};

b) modeling the surface of the moving pad by a collection of nodes located in a plane *P* parallel to said plane *w*, each of said pad nodes having a location defined by the Cartesian coordinates x_{wi}, y_{wi}, z_{pi};

c) establishing a first linear spring force at each of said pad nodes, said first linear spring force being expressed as a function of the deflection of the pad;

d) establishing a second linear spring force on each of said pad nodes as a function of the connection distance of each pad node to an adjacent pad node;

e) summing said first and second linear spring forces to determine the total force on each pad node;

f) determining the rate of change of a wafer node coordinate z_{wi} during small time segments as a function of the force applied by each pad node on a corresponding workpiece node;

g) determining the deformation of each of said pad nodes during said small time segment, by the change in location of said pad node Cartesian coordinate z_{pi} caused by the total force on each of said pad nodes on the surface of the workpiece;

h) determining the erosion of each node on the workpiece surface in said small time segment by the change in location of each of said workpiece node Cartesian coordinate z_{wi}.

12. (Currently Amended) A ~~pseudo-physical modeling~~ method for ~~use with~~ estimating the feature scale planarity that would result from a chemical mechanical polishing (CMP) process that uses a CMP system having a carrier element configured to hold a workpiece against a stack of polishing pads including a base pad and a top pad ~~during a CMP procedure~~, said ~~modeling~~ method comprising ~~the steps of~~:

a) obtaining an initial feature scale pattern associated with said workpiece;

b) acquiring a deformation model of a polishing element associated with said CMP system;

c) said deformation model including the steps of:

1) equating the base pad of a first abstract mathematical spring;

2) equating the top pad to a second abstract mathematical spring connected in series with said first abstract mathematical spring; and

d) performing a modeling routine to thereby obtain a feature scale simulation result for said workpiece, said feature scale simulation result being responsive to said initial feature scale pattern and to said deformation model, and representing an estimate of said feature scale planarity.

13. (Currently Amended) The ~~pseudo-physical modeling~~ method as defined in Claim 12, wherein:

said initial feature scale pattern is defined at a plurality of nodes; and

said deformation model utilizes said first and second abstract mathematical springs associated with one of said nodes.

14. (Currently Amended) The ~~pseudo-physical modeling~~ method as defined in Claim 13, wherein:

said performing step performs said modeling routine to generate a simulated contact profile for said polishing element in relation to a current simulated feature scale pattern, said simulated contact profile being responsive to a current state of said first and second abstract mathematical springs; and

said performing step performs said modeling routine to simulate erosion of said workpiece in response to said simulated contact profile to thereby obtain said feature scale simulation result.

15. (Currently Amended) The ~~pseudo-physical modeling~~ method as defined in Claim 13, wherein:

said performing step performs said modeling routine to determine a localized force profile associated with said polishing element in relation to a current simulated feature scale pattern; and

said performing step performs said modeling routine to stimulate erosion of said workpiece in response to said localized force profile to thereby obtain said feature scale simulation result.

16. (Currently Amended) A ~~pseudo-physical modeling~~ method as defined in Claim 13, wherein said first and second abstract mathematical springs are associated with adjacent nodes.

17. (Currently Amended) The ~~pseudo-physical modeling~~ method as defined in Claim 12 further comprising the step of:

obtaining a plurality of CMP process parameters associated with said CMP procedure, wherein said feature scale simulation result is further responsive to said CMP process parameters.

18. (Currently Amended) The ~~pseudo-physical modeling~~ method as defined in Claim 12 wherein said performing step comprises the step of estimating erosion of said workpiece in response to a simulated local force associated with said deformation model.

19. (Currently Amended) A ~~pseudo-physical modeling~~ computer system for ~~use with~~ estimating the wafer scale uniformity and feature scale planarity that would result from a chemical mechanical polishing (CMP) process performed on a workpiece by a CMP system ~~configured to perform a CMP procedure upon a workpiece with~~ having a polishing pad stack ~~having~~ with a base pad and a top pad, said ~~pseudo-physical modeling~~ system comprising:

~~means for receiving CMP data associated with said CMP procedure;~~

a processor operable ~~said means for receiving CMP data being configured~~ to receive ~~both~~ an initial feature scale pattern associated with the workpiece ~~and a deformation model of a polishing element associated with the CMP system,~~

~~said deformation model including:~~

~~means for equating the base pad to a first abstract mathematical spring;~~

~~means for equating the top pad to a second abstract mathematical spring connected in series with said first abstract mathematical spring~~;

wherein the ~~a~~ processor is further operable ~~configured~~ to perform a modeling routine ~~to thereby obtain a wafer scale simulation result and a feature scale simulation result for said workpiece,~~ ~~means for~~ by equating the base pad to a first abstract mathematical spring~~;~~ , and by ~~means for~~ equating the top pad to a second abstract mathematical spring connected in series with said first abstract mathematical spring~~;~~ and by simulating the operation of the CMP system on the workpiece, based on the initial feature scale patter; thereby providing a

~~each of said~~ wafer scale simulation result representing said wafer scale uniformity and ~~said~~ a feature scale simulation result representing said feature scale planarity ~~being responsive to said CMP data~~; and

~~said processor being further configured to obtain said feature scale simulation result in response to said initial feature scale pattern and to said deformation model;~~

wherein the processor is further operable to compare ~~means for comparing~~ at least one of said wafer scale simulation result and said feature scale simulation result to an empirical CMP result associated with said CMP ~~procedure~~ process to thereby obtain a simulation error.

20. (Currently Amended) A ~~pseudo-physical modeling~~ computer system for ~~use with~~ estimating the wafer scale uniformity and feature scale planarity that would result from a chemical mechanical polishing (CMP) process performed on a workpiece by a CMP system ~~configured to perform a CMP procedure upon a workpiece with~~ having a polishing pad stack ~~having~~ with a base pad and a top pad, said ~~pseudo-physical modeling~~ system comprising:

a processor operable ~~means for receiving CMP data being configured~~ to receive ~~both~~ an initial film thickness profile associated with the workpiece ~~and a deformation model of a polishing element associated with the CMP system,~~

~~said deformation model including:~~

~~means for equating the base pad to a first abstract mathematical spring;~~

~~means for equating the top pad to a second abstract mathematical spring connected in series with said first abstract mathematical spring~~;

wherein the ~~a~~ processor is further operable ~~configured~~ to perform a modeling routine ~~to thereby obtain a wafer scale simulation result and a feature scale simulation result for said workpiece,~~ ~~means for~~ by equating the base pad to a first abstract mathematical spring ~~means for~~ and equating the top pad to a second abstract mathematical spring connected in series with said first abstract mathematical spring~~;~~ and by simulating the operation of the CMP system on the workpiece, based on the initial film thickness profile; thereby providing a

~~each of said~~ wafer scale simulation result representing said wafer scale uniformity and ~~said~~ a feature scale simulation result representing said feature scale planarity ~~being responsive to said CMP data~~; and

~~said processor being further configured to obtain said feature scale simulation result in response to said initial feature scale pattern and to said deformation model;~~

wherein the processor is further operable to compare ~~means for comparing~~ at least one of said wafer scale simulation result and said feature scale simulation result to an empirical CMP result associated with said CMP ~~procedure~~ process to thereby obtain a simulation error.

21. Cancelled.

22. Cancelled.

23. (Currently Amended) A ~~pseudo-physical modeling~~ computer-implemented method for ~~use with~~ estimating the wafer scale uniformity and feature scale planarity that would result from a chemical mechanical polishing (CMP) process performed on a workpiece by a CMP system having a base pad and a top pad, said ~~pseudo-physical modeling~~ method comprising the steps of:

~~a) obtaining a plurality of CMP process parameters associated with a CMP procedure to be performed upon the surface of a workpiece;~~

~~b) performing a modeling routine to thereby obtain a wafer scale simulation result and a feature scale simulation result for said surface of a workpiece, each of said wafer scale simulation result and said feature scale simulation result being responsive to said CMP process parameters; and~~

~~c) producing an output indicative of at least one of said wafer scale simulation result and said feature scale simulation result;~~

~~d) obtaining an initial feature scale pattern associated with said surface of said workpiece;~~

~~e) acquiring a deformation model of a polishing pad stack having a base pad and a top pad associated with said CMP system;~~

~~said deformation model including the steps of:~~

~~equating said base pad to a first abstract mathematical spring;~~

~~equating said top pad to a second abstract mathematical spring connected in series to said first abstract mathematical spring; and~~

~~wherein said performing step obtains said feature scale simulation result in response to said initial feature scale pattern and to said deformation model~~

receiving an initial feature scale pattern and an initial film thickness profile associated with the workpiece;

performing a modeling routine by equating the base pad to a first abstract mathematical spring and equating the top pad to a second abstract mathematical spring connected in series with said first abstract spring, and by simulating the operation of the CMP system on the workpiece, based on the initial feature scale pattern and the initial film thickness profile, thereby providing a wafer scale simulation result representing said wafer scale uniformity and a feature scale simulation result representing said feature scale planarity.

24. (Currently Amended) The ~~pseudo-physical modeling~~ method as defined in Claim 23, wherein:

said wafer scale simulation result comprises a film thickness profile; and

said feature scale simulation result comprises a feature pattern profile.

25. (Currently Amended) The ~~pseudo-physical modeling~~ method as defined in Claim 24, wherein:

said film thickness profile includes global wafer uniformity information; and

said feature pattern profile includes local surface planarization information.

26. (Currently Amended) The ~~pseudo-physical modeling~~ method as defined in Claim 23, further including the steps of:

a) obtaining, prior to said performing step, an indicator of the relative importance of global wafer uniformity versus local die planarization for said workpiece; and

b) optimizing said CMP process parameters in response to said indicator to thereby produce a CMP data for use during an optimized CMP procedure.

27. (Currently Amended) The ~~pseudo-physical modeling~~ method as defined in Claim 23 further including the steps of:

a) initializing a modeling parameter associated with said modeling routine;

b) conducting said CMP procedure to obtain an empirical CMP result;

c) comparing at least one of said wafer scale simulation result and said feature scale simulation result to said empirical CMP result; and

d) adjusting said modeling parameter in response to said comparing step.

28. (Currently Amended) The ~~pseudo-physical modeling~~ method as defined in Claim 27 wherein said empirical CMP result includes a wafer scale empirical CMP result, said modeling method further including the steps of:

a) comparing said wafer scale simulation result to said wafer scale empirical CMP result; and

b) optimizing said modeling parameter such that an error between said feature scale simulation result and said feature scale empirical CMP result is substantially minimized.

29. (Currently Amended) The ~~pseudo-physical modeling~~ method as defined in Claim 27 wherein said obtaining, performing, producing, initializing, conducting, comparing, and adjusting steps are performed for an existing CMP system, and wherein said method further includes the steps of:

a) varying at least one of said CMP process parameters to thereby define an updated CMP process parameter set; and

b) thereafter repeating said performing step to thereby obtain a second wafer scale simulation result and a second feature simulation result for a theoretical CMP system, each of said second wafer scale simulation result and said second feature scale simulation result being responsive to said updated CMP process parameter set.

30. (Currently Amended) The ~~pseudo-physical modeling~~ method as defined in Claim 23, wherein said method further includes the step of obtaining an initial feature scale pattern associated with said workpiece and said performing step is responsive to said initial feature scale pattern.

31. (Currently Amended) The ~~pseudo-physical modeling~~ method as defined in Claim 30, further including the steps of:

a) initializing a modeling parameter associated with said modeling routine; and

b) optimizing said modeling parameter in response to said initial feature scale pattern.

32. (Currently Amended) The ~~pseudo-physical modeling~~ method as defined in Claim 23, wherein said method further includes the step of obtaining an initial film thickness profile associated with said workpiece and said performing step is responsive to said initial film thickness profile.

33. (Currently Amended) The ~~pseudo-physical modeling~~ method as defined in Claim 32, further including the steps of:

a) initializing a modeling parameter associated with said modeling routine; and

b) optimizing said modeling parameter in response to said initial film thickness profile.